United States Patent [19]

Grass

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[54] **LIFT DEVICE**

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Nov. 20, 1979 [DE] Fed. Rep. of Germany 2946780

[51] **Int. Cl.**[3] **B66B 9/06**

[52] **U.S. Cl.** ..... **187/12;** 74/424.8 R; 187/25

[58] **Field of Search** ..... 187/12, 14, 25, 10, 187/24; 74/424.8 R

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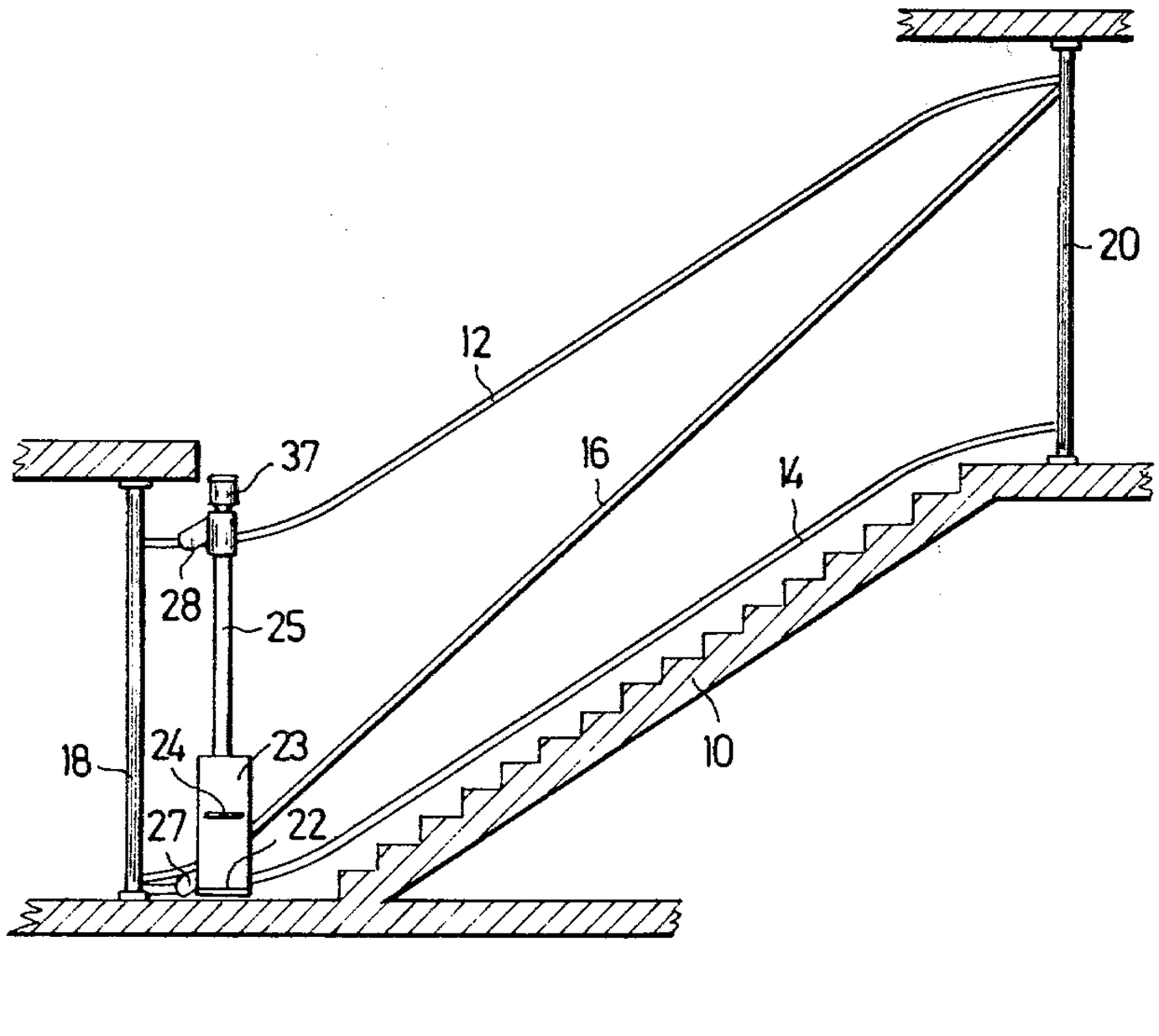
Assistant Examiner—Kenneth Noland
Attorney, Agent, or Firm—Jones, Tullar & Cooper

[57] **ABSTRACT**

A lift device comprising a driving device, a displaceable load-receiving device in the form of a platform or seat driven by the driving device, guide device for guiding the load-receiving device up or down a flight of steps, the load-receiving device being journalled for displacement and a drive spindle for effecting the displacement, the drive spindle being provided on the load-receiving device so as to be displaceable therewith, support rails secured alongside the flight of steps for guiding the spindle, the spindle having a thread and the support rails including a guide device having a thread co-operating with the spindle thread, the co-operation of the threads determining the path of travel of the load-receiving device.

9 Claims, 9 Drawing Figures



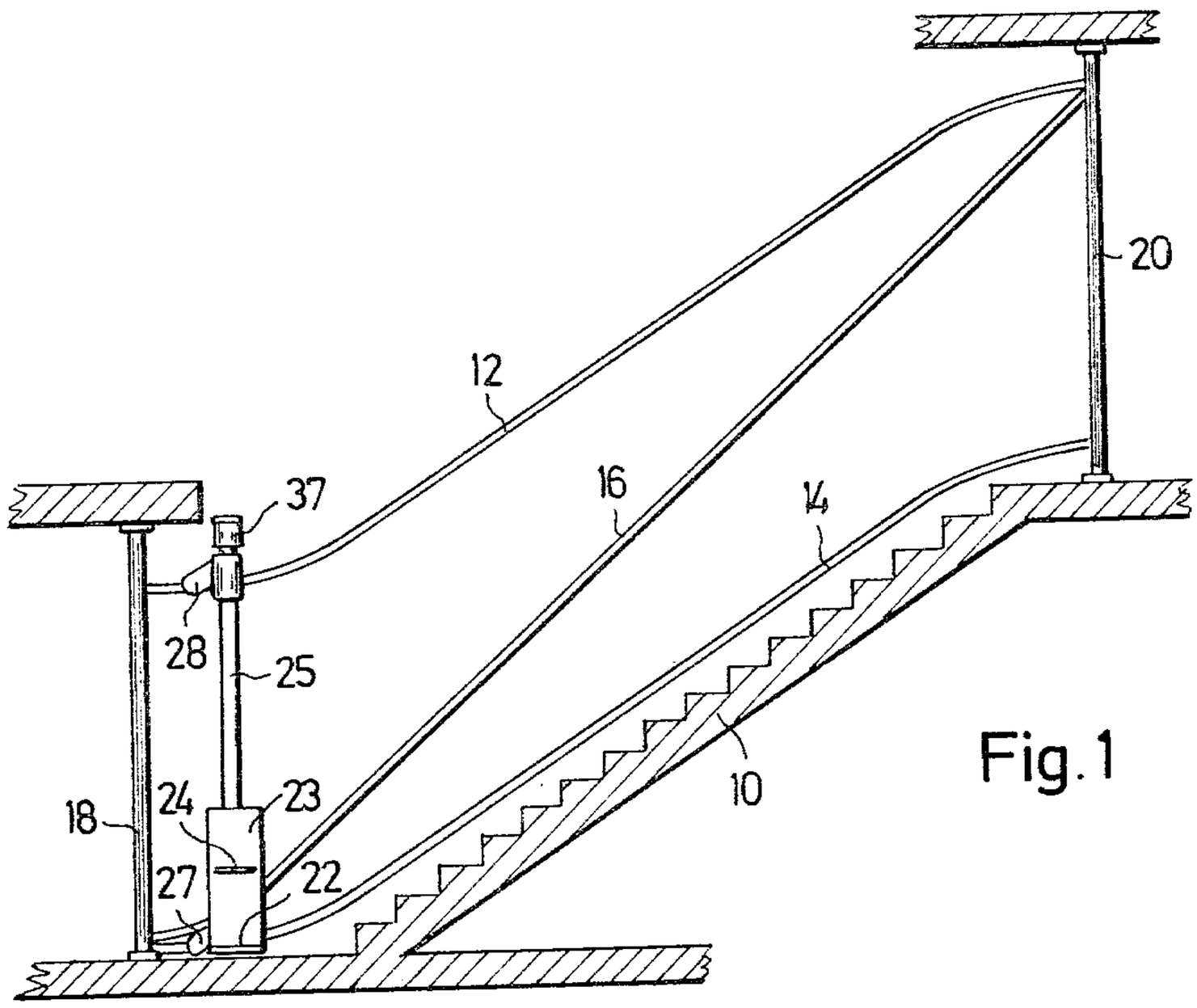

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Fig. 1

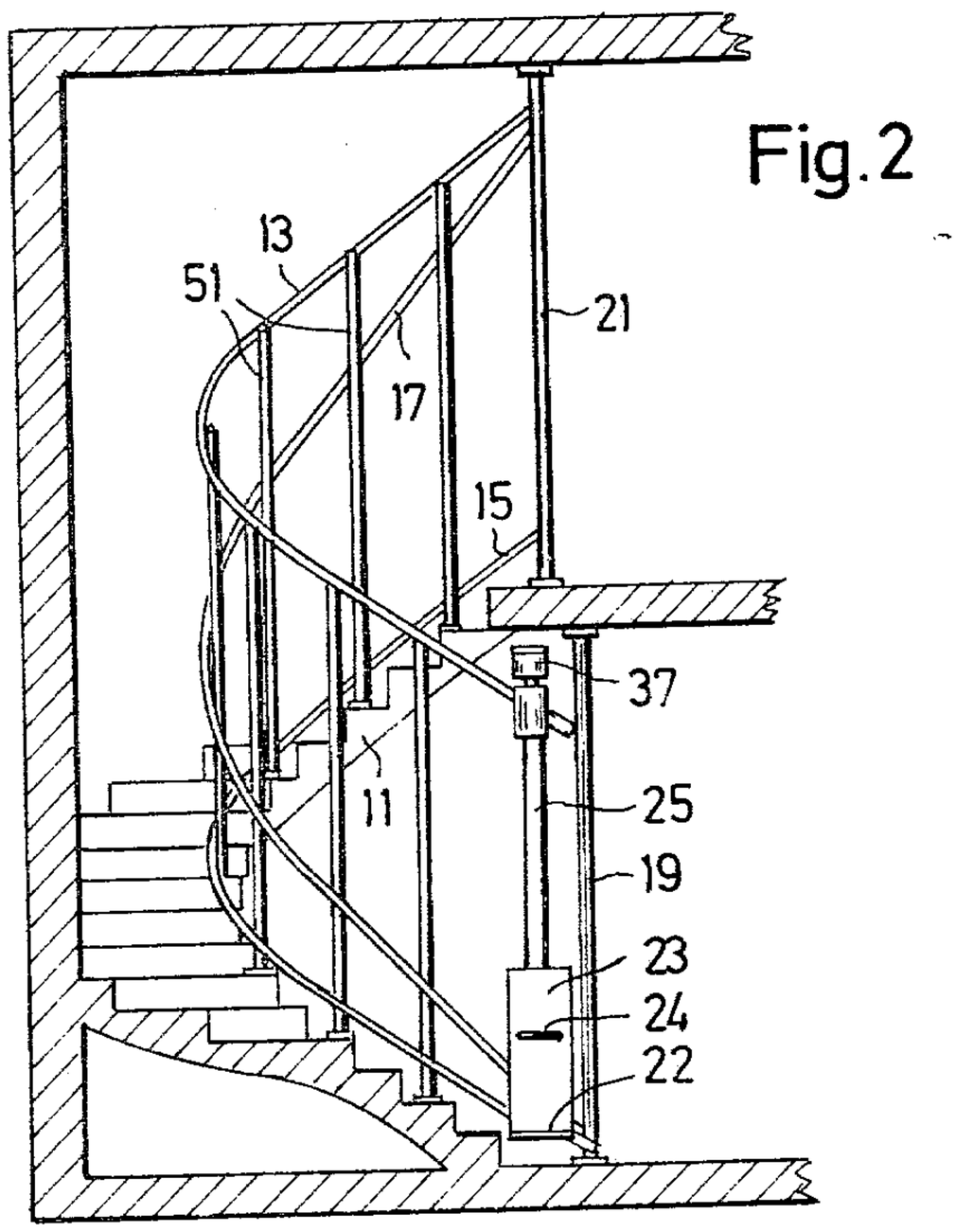
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Fig. 2

Fig. 3

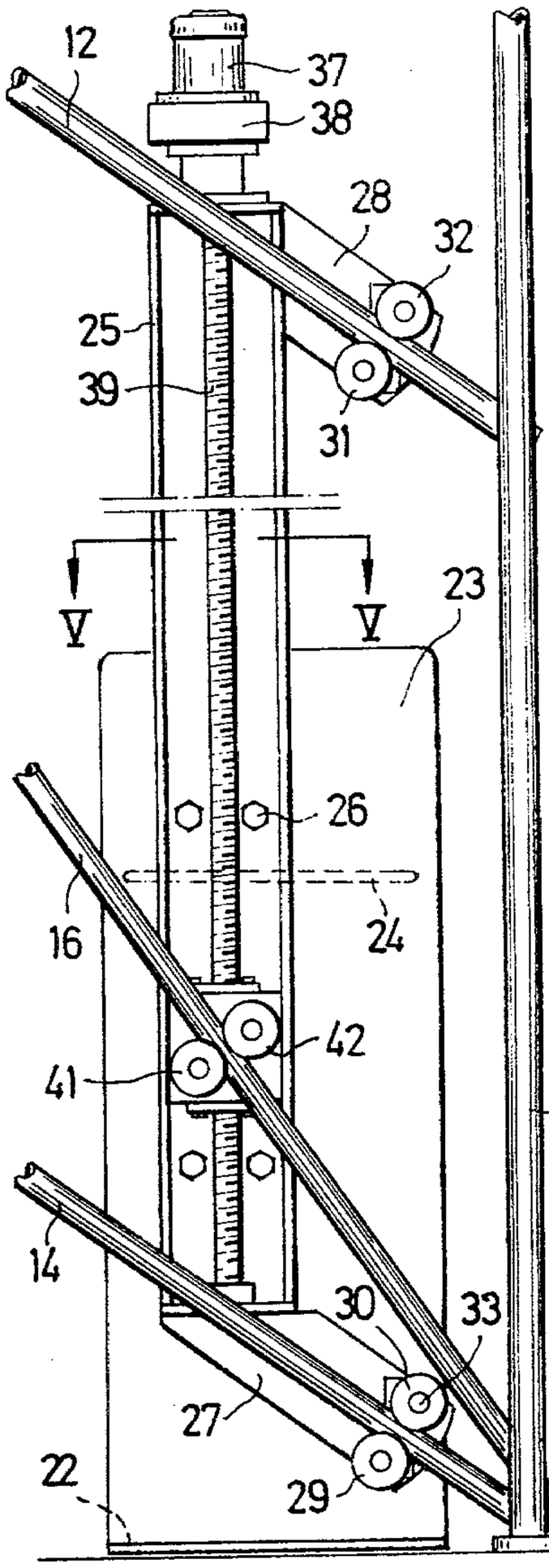


Fig. 4

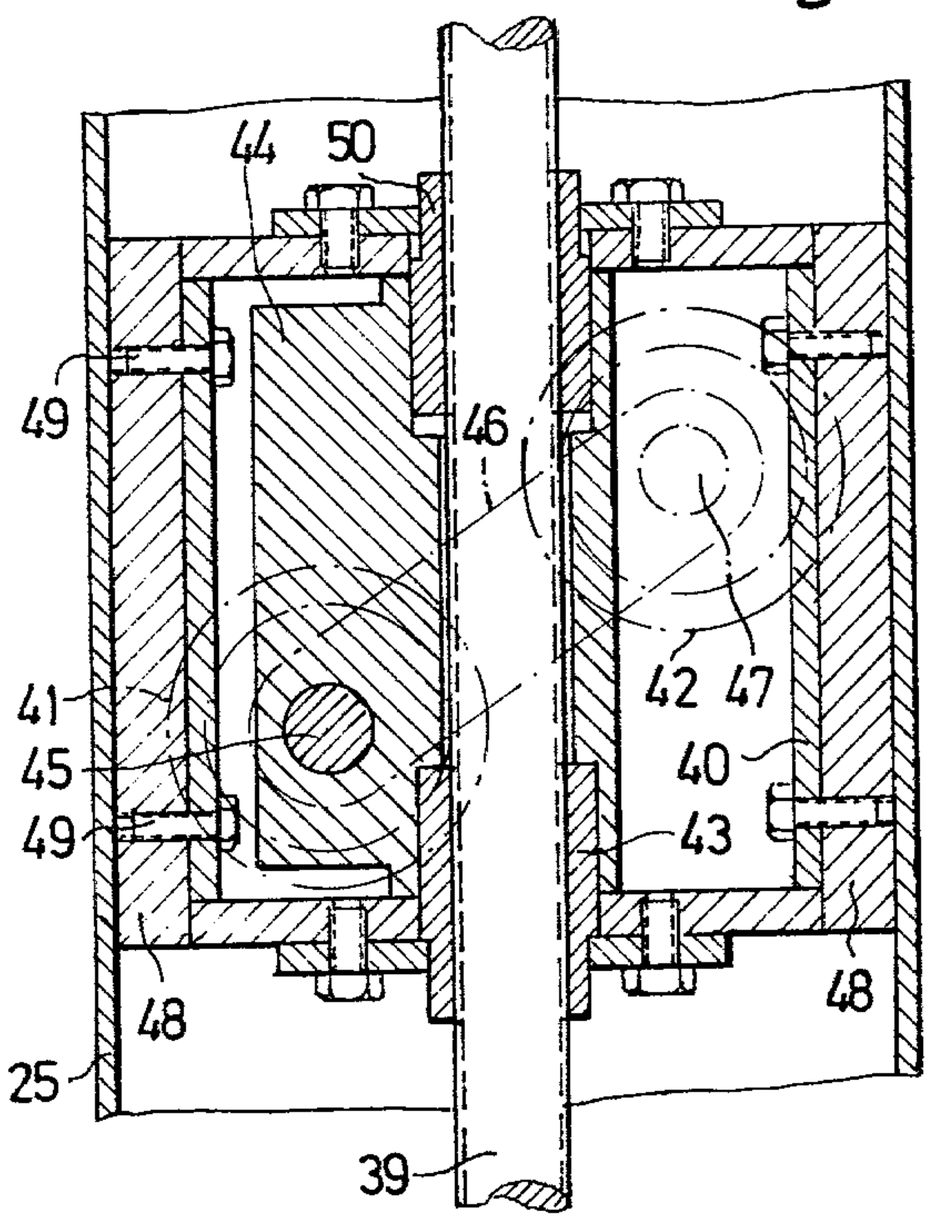


Fig. 5

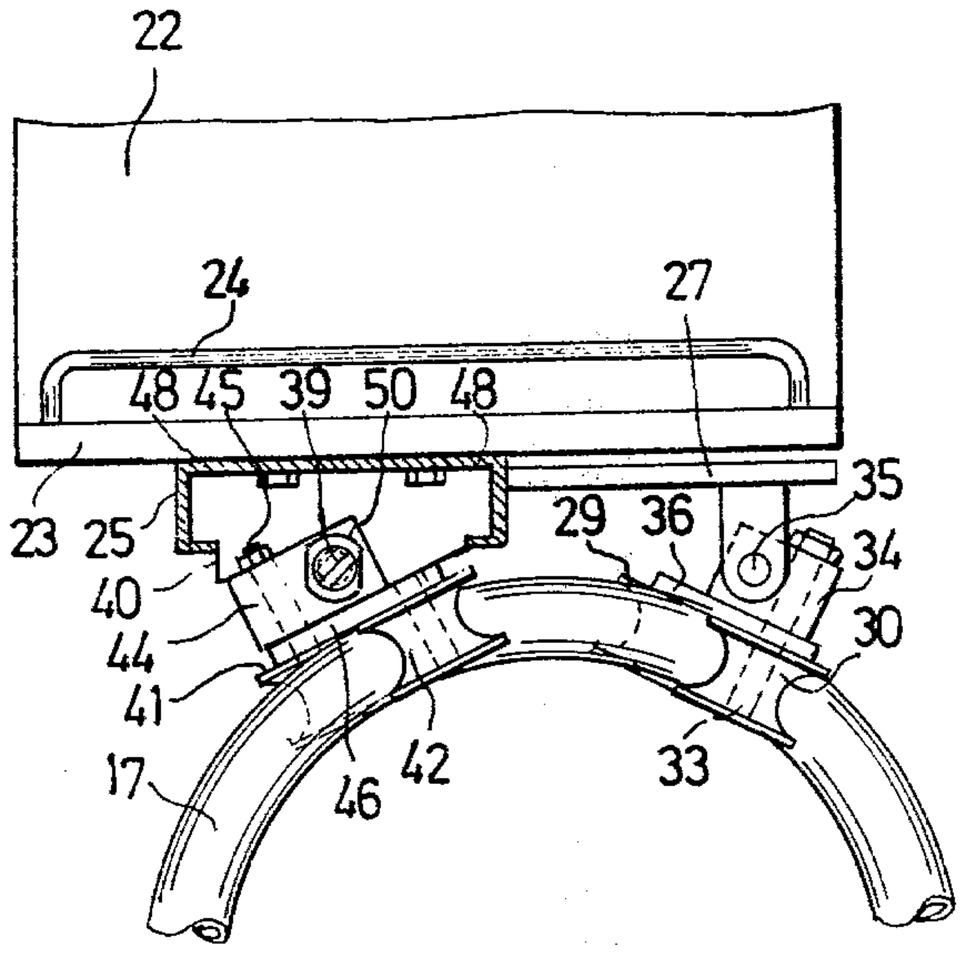


Fig. 6

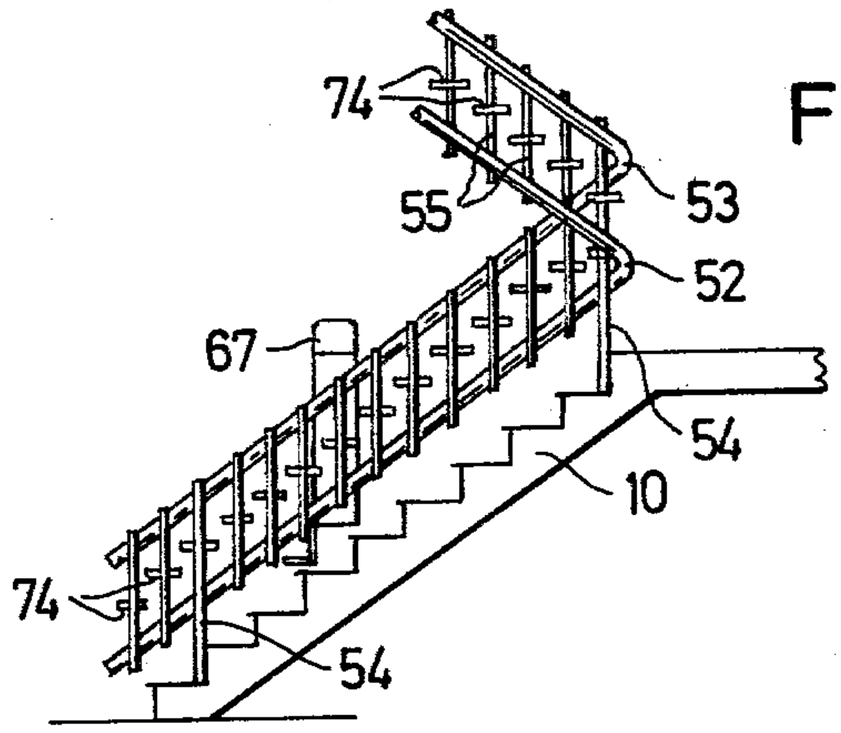


Fig.9

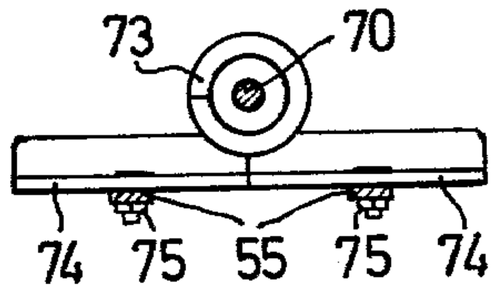


Fig.7

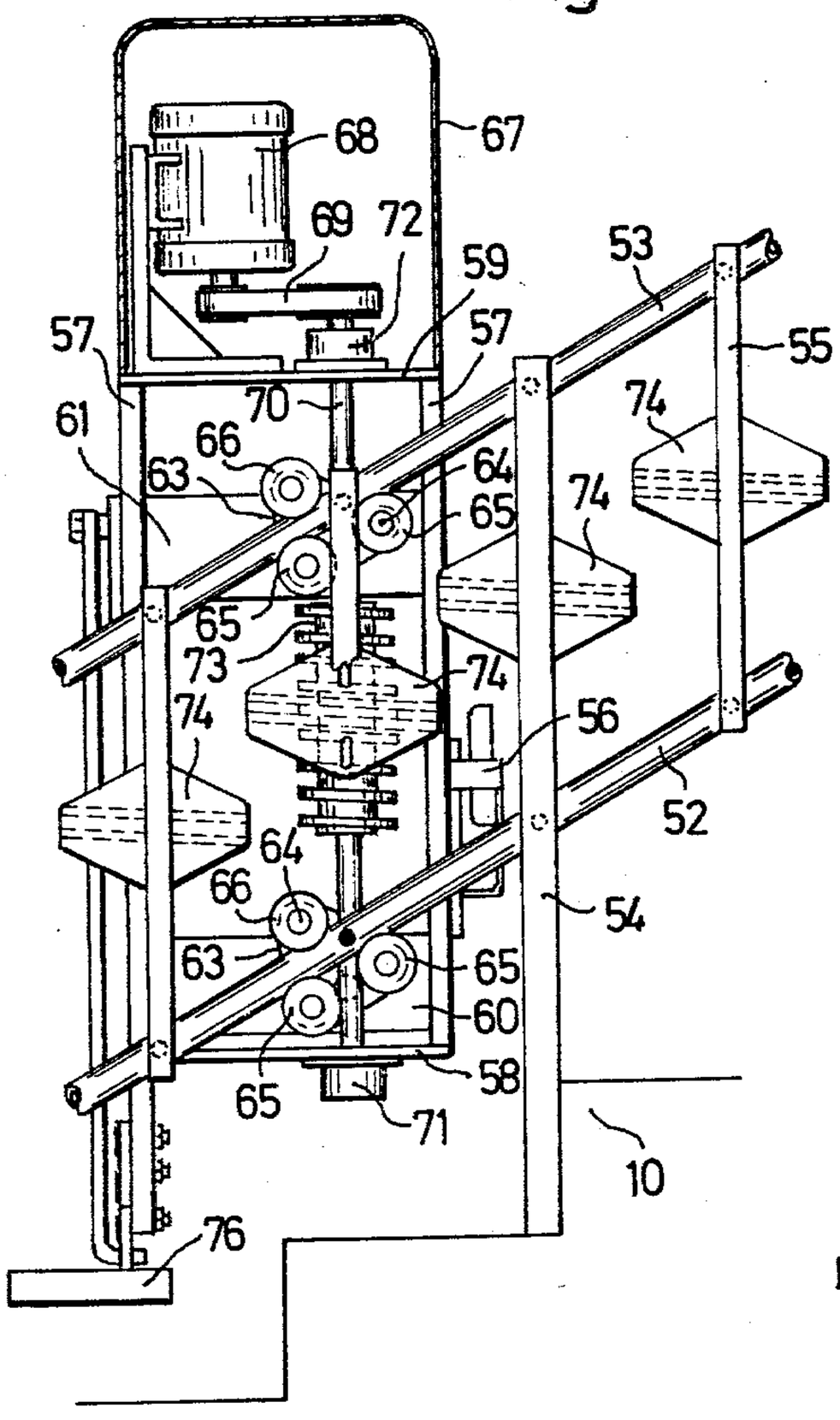
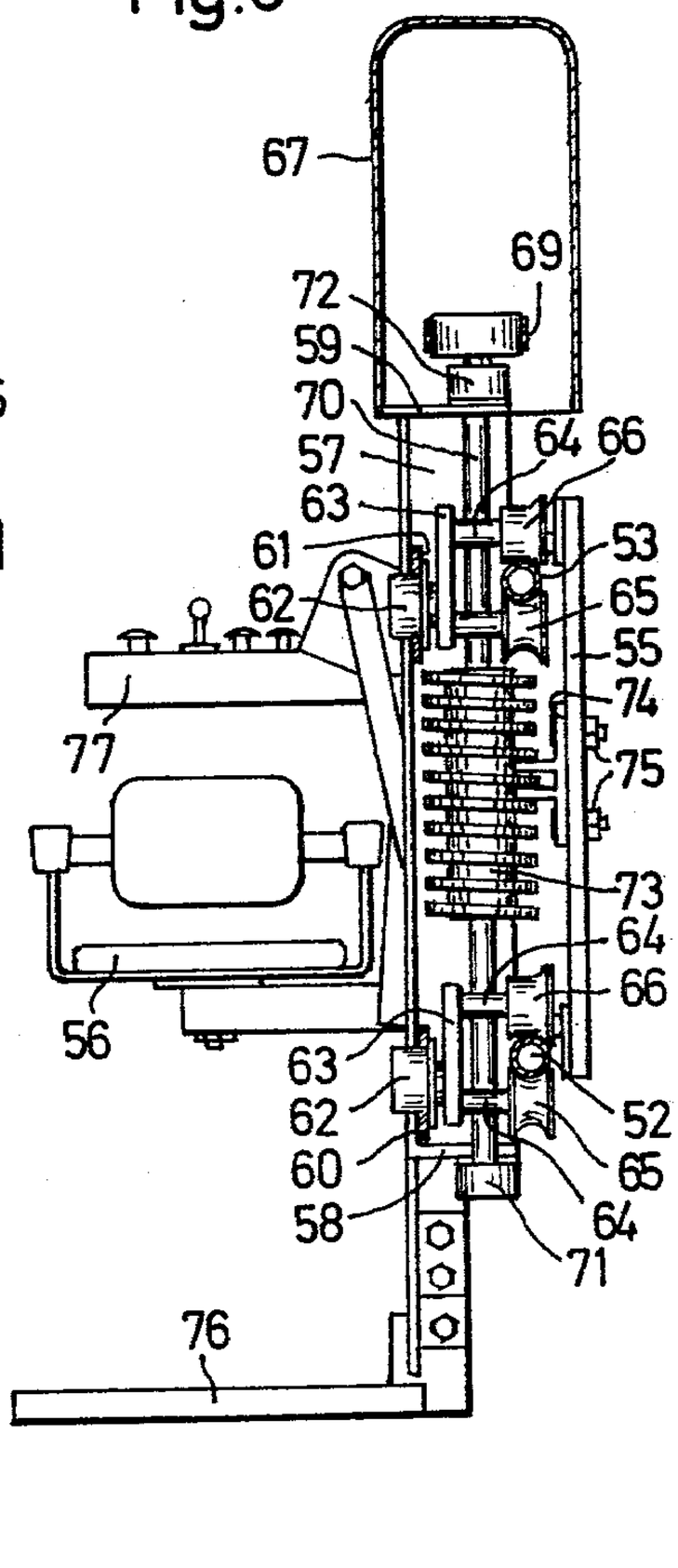


Fig.8



LIFT DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lift device of the type which comprises a driven load-receiving member in the form of a platform or seat which is guided along a flight of steps. Such hoist or lift devices are used, for example, as emergency lifts and can be fitted onto existing staircases.

2. Description of the Prior Art

U.S. Pat. No. 2,270,735 discloses a lift in which a platform acting as a load-receiving member is displaceably mounted by means of a lifting spindle extending at a fixed angle with respect to the gradient of the steps.

Using such a driving spindle the load-receiving device can be moved only in straight lines and not around curves. Such a construction also fails to comply with certain safety regulations.

The present invention seeks to provide a lifting device of relatively simple construction which fulfils the safety regulations, gives maximum room for the load-receiving device and can pass around corners but which does not reduce the free width of the flight of steps.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a lift device comprising drive means, a displaceable load-receiving device in the form of a platform or seat driven by said drive means, guide means for guiding said load-receiving device up or down a flight of steps, said load-receiving device being journalled for displacement and a drive spindle for effecting said displacement, said drive spindle being provided on said load-receiving device so as to be displaceable therewith, support rails secured alongside said flight of steps for guiding said spindle, said spindle having a thread and said support rails including a guide device having a thread co-operating with said spindle thread, said co-operation of said threads determining the path of travel of said load-receiving device.

In a preferred embodiment, said guiding device comprises a spindle nut, said spindle nut being journalled on said load-receiving device and surrounding said drive spindle, an additional guide rail being provided for guiding said spindle nut, said additional guiding rail extending alongside said flight of steps and being inclined relative to said support rails.

In such a lifting device, no chains or cables are required as bearing and traction means. No additional brake or safety device on the lifting device are necessary, since the drive by the driving spindle and the spindle nut is irreversible. The preferred arrangement of a second, unloaded spindle nut, in addition to the spindle nut transferring the movement, fulfils the requirement of the legally prescribed safety measures in a simple manner. The speed of the load-receiving device can be altered as desired by changing the angle of inclination of the guide rail, so that, for example in moving round a curve, it can be reduced in a spiral region of the steps with the result that any resulting centrifugal forces can be reduced. Such a reduction of the driving speed, produced by simple constructional measures, contributes to the safety of the user.

In a modified embodiment, said drive spindle is provided with a worm, the thread of said worm meshing with an associated worm wheel, the thread of which is developed and is provided on a plurality of identical segment plates fixedly arranged along the flight of steps and extending parallel thereto on said support rail, said plates having a partial thread as guiding device.

Such an embodiment is particularly suitable for use with long flights of steps, since any desired number of segment plates can be fixed at suitable spaced intervals along the sides of the steps. Continuous tubes or the like extending along the steps as separate guide means are unnecessary. The support rails may replace handrails in this case.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

FIG. **1** shows a lift device fitted on a straight flight of steps;

FIG. **2** shows a lift device fitted on a spiral flight of steps;

FIG. **3** shows a rear view on an enlarged scale, of the lift device shown in FIGS. **1** and **2**;

FIG. **4** shows a vertical section, on a further enlarged scale, through the connecting region of a lift unit and a guide rail therefor;

FIG. **5** shows a sectional view taken along the line V—V of FIG. **3** taken at a point at which the guide rail is passing through a curve;

FIG. **6** shows a schematic side view of a flight of steps with the lift device in operation;

FIG. **7** shows a partial vertical section from one side of the lift device fitted on a flight of steps;

FIG. **8** shows a partial vertical section taken from the front of a lift device fitted on a flight of steps; and

FIG. **9** is a plan view of the worm seen in FIGS. **7** and **8** in engagement with the teeth of two adjacent segment plates also visible in FIGS. **7** and **8**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. **1** and **2**, there is shown a lift device fitted on a staircase which, in FIG. **1**, comprises a straight flight of steps **10** and in FIG. **2** comprises a spiral flight of steps **11**. The lift unit is supported on an upper support rail **12** (FIG. **1**) or **13** (FIG. **2**) and a lower support rail **14** (FIG. **1**) or **15** (FIG. **2**). Connecting the upper support rail **12** or **13** and the lower support rail **14** or **15**, is a guide rail **16** or **17**, the rail **16** or **17** connecting one end of the upper rail **12** or **13** to the opposed end of the lower rail **14** or **15**. The rails **12**, **14** and **16** or **13**, **15** and **17** are located perpendicularly above one another and are each secured to a lower support member **18** (FIG. **1**) or **19** (FIG. **2**) at the lower end of the flight of steps and to an upper support **20** (FIG. **1**) or **21** (FIG. **2**) at the upper flight of steps. These supports extend vertically from the floor to the ceiling in a storey of a building.

The guide rail **16** or **17** determines the position of the lift unit along the steps. It extends from the lower end of the lower support rail **14** or **15** at the lower end of the flight of steps to the upper end of the upper support rail **12** or **13** at the upper end of the flight of steps. The support rails **12** to **15** and the guide rails **16** and **17** may be made from tubular material.

The lift unit comprises a horizontal platform **22** provided with a vertical wall **23** on which a shackle **24** is provided. Secured to the rear face of the wall **23** is a substantially C-shaped guide section **25**, the securing

being effected by means of bolts **26**. The guide section **25** extends substantially vertically. On its lower end a lower gib **27** is secured and at its upper end, an upper gib **28** is secured. These gibs **27**, **28** extend substantially parallel to the support rails **12** to **15** and are each provided, at their free end, with bearing rollers. The lift device is supported on the rails **12** and **14** or **13** and **15** by these bearing rollers. Thus, at the free end of the lower gib **27**, a lower bearing roller **29** and an upper bearing roller **30** are provided, the rollers **29** and **30** being disposed on opposite sides of the lower support rail **14** or **15**. In the same manner, the free end of the upper gib **28** is provided with a lower bearing roller **31** and an upper bearing roller **32** which are disposed on opposite sides of the upper support rail **12** or **13**.

The upper bearing roller **30** has a horizontal swivel axis which is journalled in a swivel bearing having a vertical axis, the swivel bearing being provided on the associated gib. The lower bearing roller **29** is journalled on a swivel lever rotatable about the swivel axis of the bearing roller. Thus, as shown in FIG. **5** of the drawings, the upper bearing roller **30** is linked by its swivel axle **33** to a bearing body **34** which latter is journalled by means of a swivel bearing **35** having a horizontal axis, to the gib **27**. The swivel lever **36** is journalled on the bearing body **34** so as to rotate about the swivel axle **33**; the lower bearing roller **29** being journalled to rotate at the free end of the lever **36**. The lift unit is thus suspended from the support rails **12** and **14** or **13** and **15** by means of the bearing rollers **29** to **32** and can therefore travel on the support rails.

The drive unit of the lift device is located on the travelling lift unit and is in engagement with the guide rails **16** or **17**. Such drive unit comprises a drive motor **37** provided on the upper end of the guide section **25**, an associated gear system **38** and a vertical drive spindle **39** which is located within the guide section **25**, the ends of the drive spindle being mounted on the guide section **25**. The spindle **39** is joined to the guide rails **16** or **17** by means of a support frame **40**, a lower bearing roller **41** and an upper bearing roller **42**.

A spindle nut **43** is screwed onto the spindle **39** which acts as a guide device for the platform **22**, which supports a bearing block bracket **44** enclosing the driving spindle **39**. Inserted in a horizontal bore of this bearing block or bracket **44** is the axle **45** of a lower bearing roller **41** and of a swivel lever **46**. On the free end of the axle **45** is mounted the upper bearing roller **42** having a horizontal axis **47**. The lower bearing roller **41** and the upper bearing roller **42** are disposed on opposite sides of the guide rail **16** or **17** but externally of the guide section **25**.

The bearing bracket or block **44** is disposed within the support frame **40** on which it is supported at its upper and its lower end, so that it must move therewith. The support frame **40** is displaceable in a vertical direction within the guide profile or bracket **25**. For this purpose it is provided on two of its vertical outer faces with guide shoes **48**. The shoes **48** are secured to the support frame **40** by means of bolts **49**.

The bearing block or bracket **44** enclosing the drive spindle **39** is retained in a radial direction by the spindle nut **43** at its lower end and by a second spindle nut **50** at its upper end. It has vertical bores, the inner circular cylindrical upper surface of which are disposed against the outer surfaces of the spindle nuts **43** and **50**. The bearing bracket or block **44** is vertically spaced with a small clearance, from the second spindle nut **50**. This clearance is located at the lower end of the spindle nut **50**. Moreover, the support frame **40** which, like the bearing block **44**, is radially retained by the spindle nuts **43** and **50**, is not in direct contact with the second spindle nut **50** in the axial direction of the drive, but maintains a small clearance therefrom. The support frame **40** and the bearing block or bracket **44** are thus retained against the drive spindle **39** only by means of the spindle nut **43**. If, however, the nut **43** should become defective and fail, the retention is assumed by the second spindle nut **50**. This provision of two spindle nuts **43** and **50** therefore provides a safety device so that the platform **22**, which acts as a load receiving means is retained even if the main spindle nut **43** fails.

The operation of the lift device of the present invention will now be described.

Initially, the platform **22** is disposed at the lower end of a flight of steps. The drive motor **37** is switched on and by means of the gearing **38**, causes the drive spindle **39** to rotate about its axis. The spindle nut **43** is secured to the support frame **40** in the radial direction and thus cannot rotate about its axis. When the drive spindle **39** rotates the spindle nut **43** must therefore move upwardly. At the same time, the bearing block **44** and the support frame **40** are caused to move therewith, the block and frame being displaced upwardly within the guide section **25**. Since the bearing block or bracket **44** and the support frame **40**, are also retained by the guide rail **16** or **17** by means of the bearing rollers **41** and **42**, the rising movement within the guide section **25** can only take place when the guide rail **16** or **17** permits such movement. In other words, the movement can only occur when support rollers **41** and **42** can roll on the guide rails **16** or **17**. Since the guide rails **16** or **17** are inclined, a vertical rising movement of the bearing block or bracket **44** necessarily involves movement of the guide profile **25** along the upper support rail **12** and the lower support rail **14** (or **13** and **15**). The platform **22** therefore moves upwardly along the support rails alongside the steps **10** or **11**. The downward movement thereof is effected by causing the drive spindle **39** to rotate in the opposite direction.

The main advantage of the present invention resides in that feature that a minimum number of rails need to be provided on the edge of the steps for the lift device. They may be provided on each side of the steps and together with additional limit rods **51**, may serve as hand-rails. As shown in FIG. **1** of the drawings, the incline of the upper and lower support rails **12** and **14** in their end regions may be made variable. Thus, the rails may pass from a horizontal disposition into a constantly inclined disposition through a transition region at their lower ends. They then maintain this constant incline for the length of the steps and then pass through a second transition region from the inclined disposition into a horizontal disposition at their upper ends. Since the angle of incline of the guide rail **16** is substantially constant, the rails **12** and **14**, which terminate at different angles of inclination, cause the speed of travel of the lift unit to be reduced in the end regions of these rails.

The use of the C-shaped guide profile or section affords further possibilities for the use of the lift. If, for example, the track defined by the support rails **12** and **14** and the guide rail **16** (FIG. **1**) is rotated so that the rails **12** and **14** extend vertically, the lift can travel in a vertical direction. At the same time, the C-shaped guide section **25** and the driving spindle **39** retain their angular position relative to the support rails **12** and **14**, whilst

the platform **22** is so arranged relative to the guide section **25** that it remains horizontal. A horizontal direction of motion for the unit may be provided in a similar manner.

In the case of the embodiment shown in FIGS. **6** to **9**, a lift device is suspended from a guide which can simultaneously serve as a banister. This guide comprises a lower guide or support rail **52** extending along the steps **10** and an upper guide or support rail **53** extending parallel thereto. These guide or support rails are retained by means of vertical supports **54** located above and on one side of the steps **10** and which are secured thereto. A plurality of cross bars **55** are secured to the guide rails **52** and **53** between two successive supports **54** at identically spaced intervals.

The load-receiving device of the lift, to which a side-seat **56** is secured near the steps **10**, is suspended from the two guide rails **52** and **53** so as to be free to travel therealong. For this purpose, the guide rails **52** and **53** are made of tubular material of circular cross-section so that support rollers **65**, can roll therealong. The load-receiving device is in the form of a frame having two vertical side struts **57**, a lower cross strut **58**, an upper cross strut **59**, a lower connecting strut **60** and an upper connecting strut **61**. The suspension of the frame on the guide rails **52** and **53** is effected by means of the connecting struts **60** and **61**, each of which carries a plurality of support rollers capable of rolling along the guide rails.

A vertical roller support plate **63** is journalled to pivot on each connecting strut **60** and **61** in a bearing **62** secured thereto, the bearing having a horizontal axis. Fixed bearing pins **64** project horizontally from this roller bearing plate **63** and rotatably support two lower bearing rollers **65** and an upper bearing roller **66**. The upper bearing roller **66** is supported against its associated guide rail **52** or **53** from above, the upper guide or support rail **53** extending parallel thereto.

The two lower support rollers **65** are supported one behind the other in the direction of travel of the lift device from below against the guide rail **52** or **53**. The load-receiving device of the lift device may be adjusted relative to the guide rails **52** and **53** in this manner during its travel therealong to compensate for minor deviations in the parallelism of the rails. The support rollers **65** and **66** are each pivotally mounted on a pivotal roller support plate **63**. For the drive of the lift device, a motor **68** located in a housing **67** and having a belt drive **69** is provided. The belt drive **69** drives a vertical driving spindle **70**. The spindle **70** is rotatably mounted in a lower spindle bearing **71** secured to the lower cross strut **59** and in a spindle bearing **72** secured to the upper cross strut **59**. To transmit the torque, the principle of a worm gear or the like is used. Accordingly, a worm or screw thread **73** is provided on the working spindle **70**. Such thread does not, however, engage in a conventional worm gear. The threads in which it engages are distributed over a plurality of segment plates **74** acting as guide devices. A segment plate **74**, secured by screws **75** is secured to each support **54** and to each rung **55** substantially centrally thereof between the two guide rails **52** and **53**. In the inoperative position, the lift device is suspended on the guide rails **52** and **53**. Since the thread of the worm **73** is in engagement at least with one segment plate **74** acting as a guide device, the load-receiving device is retained by means of the worm drive. Depending on the circumstances, the worm gear may be made self-locking. Thus, it is not possible for the weight of the load-receiving device to cause the worm **73** to start rotating of its own accord. However, as soon as the drive spindle **70** and, together therewith, the worm **73** are rotated, the worm engages with the thread of the segment plates **74** of the load receiving device and is compelled to move along the guide rails **52** and **53**.

The manner of operation of the motor **68** can be controlled by the operator who is seated on the seat portion **56** utilising a control panel **77**. The seat may be provided with a foot rest **76**. The seat **56** can be easily dismantled and the foot rest **76** and control panel **77** can be easily raised if it is desired to utilise the full width of the flight of steps. This may be useful for transporting large items.

In the embodiment described, the drive spindle **70** and its associated worm **73** are arranged vertically. However, embodiments are also possible in which the drive spindle has a different orientation, such as inclined or horizontal. In such a case, the guide rails **52** and **53**, acting as support rails, may be arranged in any desired direction.

The lift device of the present invention may also be in the form of a traction engine which pulls a plurality of load-receiving devices in series so that a plurality of persons and/or goods can be conveyed simultaneously.

I claim:

1. A lift device for moving a load receiving device such as a platform or a seat up or down a flight of stairs, said lift device comprising:

a vertical, threaded drive spindle rotatably secured to said load receiving device and movable therewith;

spaced support rails secured along the flight of stairs for supporting and guiding said spindle and said load receiving device;

guide means extending along the stairs intermediate said support rails;

drive means for rotating said drive spindle;

and

means cooperating with said drive spindle and said guide means to cause said load receiving device to move up or down along the stairs as said drive spindle is rotated.

2. The lift device of claim **1** wherein said guide means is a guide rail extending along the stairs between said support rails and being inclined relative to said support rails.

3. The lift device of claim **2** wherein said means cooperating with said drive spindle and said guide rail is a spindle nut journaled on said load receiving device and engaging said drive spindle, said spindle nut being supported by upper and lower bearing rollers in contact with opposed faces of said guide rail, said drive means rotating said spindle so that said spindle nut is caused to raise or lower along said drive spindle to move said upper and lower bearing rollers along said inclined guide rail to move said load receiving device up or down the flight of stairs.

4. The lift device of claim **3** wherein said lower bearing roller is journaled in a bearing block slidably carried by said load receiving device, said lower bearing roller further including a swivel lever pivotably mounted about an axis of said lower bearing roller, said upper bearing roller also being journaled on said swivel lever.

5. The lift device of claim **4** wherein said bearing block encloses said drive spindle and supports a bearing frame, said bearing block carrying said spindle nut and further wherein a second spindle nut is carried by said

bearing block and engages said drive spindle, said second spindle nut being spaced from said spindle nut and having a small clearance in an axial direction relative to said bearing block and said bearing frame.

6. The lift device of claim **1** wherein said threaded drive spindle is provided with a worm thread, said worm thread meshing with an associated worm wheel, the thread of said worm wheel being provided on a plurality of identical segment plates fixedly arranged along the flight of stairs and extending parallel to said support rails, said segment plates forming said guide means.

7. The lift device of claim **1** wherein said load receiving device is in the form of a frame having two vertical side struts, a lower horizontal cross strut, an upper horizontal cross strut and connecting struts arranged between said struts, said drive spindle being secured to said cross struts and said load receiving device being supported by support rollers which engage said support rails.

8. The lift device of claim **1** wherein each said support rail has at least an upper and a lower roller associated therewith, said upper and lower roller associated with each said support rail being journaled to rotate on a common roller bearing plate.

9. A lift device in accordance with claim **8** wherein each of said roller bearing plates is journaled to pivot about a horizontal axis in a bearing secured to said load receiving device.

* * * * *